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CLADOCERA.

Daphnella brachyura, Lievin. *Daphnia cederströmii*, Schoedler. *Ceriodaphnia*, *nov. sp.* *Chydorus sphæricus*, O. F. Müller. *Leptodora hyalina*, Lilljeborg.

[The above forms regarded as new will be described in time for a paper at the next annual meeting of the Society.]

PHOTOGRAPHY.

The session was opened by Mr. Griffith, the Director, announcing that Messrs. J. D. Cox and W. H. Walmsley had consented to take charge of the subject of photography by lamplight, in its application to the microscope.

Mr. Cox, for himself and Mr. Walmsley, stated that the plan they had thought most likely to be profitable was to give some examples of actual work on microscopic objects with the camera, interspersed with discussion of practical questions, and of points suggested by members of the Society as the illustrations proceeded. Mr. Walmsley had consented to perform the manipulations, and he (Mr. C.) would discuss the steps taken in the intervals when Mr. W. might be off the platform engaged in the "dark room" work.

Mr. Walmsley first exhibited the apparatus to be used, which is an improvement upon that which has been frequently illustrated by engravings in the microscopical journals. The camera is constructed with a door in the side for reaching the inner partition used in copying photographs, but when this is closed the general construction does not differ from the common double bellows camera with conical front for receiving the microscopic tube. The frame for the extension of the camera and clamping it, is hinged so that it may be easier to pack for transportation. The ground glass screen at the back of the camera has a small clear disc in the center, made by cementing a circular "cover-glass" on the ground glass surface with Canada balsam, which obliterates the roughness, making this spot transparent. By this arrangement the ground surface is used for coarser focusing and the transparent spot for the finer adjustment of the focus by aid of a Darlot focusing glass.

Mr. Walmsley explained that the only change he had recently made in his arrangement of the microscope and light was to discard condensers (with the lower powers) and to be less desirous of secur-

ing extremely brilliant lamplight than formerly. Any good coal-oil lamp with a broad flat single wick was quite sufficient for the purpose. Of course the rejection of the condensers implied a lengthening of the time of the exposure of the plate, but his experience seemed to prove that the increase of excellence in definition and brilliancy of details more than compensated for the added time employed. The lenses he should use were Beck's lower powers adapted to photography by the insertion of a concave lens behind the usual combination of the objective. The plates he should use were the but any of the standard dry plates for quick work, Eastman, Diamond, Seed, would give good results. His developer was an alkaline pyro-gallic acid developer not greatly varying from the standard developers of that class. The difficulty of complete exclusion of light from the lecture-room made it necessary to develop his plates in an adjoining dark room, where he regretted there was not room also for the members of the society.

Whilst Mr. Walmsley was now busy in arranging the apparatus and centering an object on the camera screen, Mr. Cox resumed the discussion by calling attention to the fact that the rejection of condensers in illuminating the object, and the consequent increase of time of exposure, was an application to photo-micrography of the principle so well known in landscape photography, that if it be desired to bring out the finer details in shadow, some method of increasing the time of exposure must be used. A similar thing had been noticed in astronomical photography, where stars too faint to be seen with the telescope were revealed by the sensitive plate if the exposure were sufficiently prolonged. It would seem that the impression was not so much due to the vividness of the light as to oft-repeated impact of even the faintest light waves. He thought it might be considered a valuable discovery in the microscopical department of the work, that it is not the intensest light which is needed,—nay, that in photography, as in investigation with the microscope, there is a positive danger of "drawing out" the details, or at least of injuring them, by too much light. Mr. Walmsley had referred to the use of lower powers, but within reasonable limits the same thing was true of the higher powers. In using a tenth or fifteenth objective, the speaker had not found it practicable to dispense

with the condenser as Mr. W. did with a "two-thirds" or a "quarter" inch; but he had often observed that the mild, soft light of the coal-oil lamp had, with the higher powers, the same desirable effects which, with the low powers, were obtained by the rejection of the condenser. In using sunlight, the intensity of the illumination makes it difficult to avoid diffraction phenomena; objects seem to scintillate, especially at broken edges (as of a diatom shell), and are fringed, both to the eye and in the photograph, with brushes of light or parallel diffraction lines which interfere with true resolution. He thought the same difficulties likely to attend the use of electric light, in some degree at least, and suggested that the practical example before us taught the lesson of photographing microscopic objects with the most reduced light which is consistent with a reasonable time of exposure. Instead of being impatient to approximate the sunlight with our artificial illumination, we should recognize the fact that the cheapest and most easily accessible of all lamps is as satisfactory in its results as it is cheap and common, if only you give it *time*.

Mr. Walmsley now exposed a plate, the object being a section of Echinus spine and the objective a Beck two-third, adapted for photography as above stated. Mr. W. explained that if using a strong light with condensers two or three seconds would be a sufficient exposure, but that without these the exposure would be about five minutes. The lamp was placed so that the edge of the flame was toward the object, and about four inches from it. He strongly advised the use of the adapted objectives (of low and medium powers) as there was no embarrassment when using them with the question whether the visual and actinic focus were the same. One had simply to make the sharpest and best picture possible on the camera screen, and if the table were steady and there was no "springing" of the parts of the apparatus, the result was reasonably sure to be a success. In response to a question, he said he used the microscope without the eye-piece in this work, but as he rarely went beyond an amplification of four or five hundred diameters, he would not affirm as to the desirability of doing this with the highest powers.

When the plate was taken to the dark room for development, the

discussion returned to the use of the eye-piece in photographing. Mr. Cox said that his own work had been almost exclusively with amplifications ranging from 750 to 2,000 diameters, and that for this work he invariably used the microscope with the eye-piece. In using low powers, and especially in using objectives adapted for photography, there were reasons why it would sometimes be convenient to omit the eye-piece. It might be necessary to do so for the purpose of getting an illuminated field large enough upon the screen of the camera, or to reduce the amplification whilst using a favorite objective. With high powers, however, the consideration which is decisive with him is that the microscope was made to be so used. It is a compound instrument. The optician has constructed it with reference to use with the eye-piece. He has laboriously corrected the imperfections which the eye-piece discloses. To take away the eye-piece, therefore, is to risk undoing some of the corrections which the optician has labored upon, and to injure the image instead of improving it. To argue, therefore, that removing the eye-piece is to remove also a cause of injury to the image seemed to him illogical. No one would say it would help an objective to take out a lens from its system. It might be desirable to make an objective with fewer lenses; but once made, it must be used as was intended by the maker. Although the argument as to the eye-piece does not go "on all fours" with this, it is analogous.

But it should also be remembered that before undertaking to photograph a delicate object, it has been studied under certain conditions. We have carefully adjusted the objective for the thickness of the cover-glass; we have used a particular eye-piece and perhaps a particular obliquity of light. Is it not reasonable to expect the most satisfactory results when we reproduce, as far an possible, the conditions under which we obtained the best picture for the eye? May not a change of any of these conditions involve a change of the others? If the photograph does not show us what we saw in the instrument, it will be very unsafe to say that this is a more accurate picture than the one we saw. When we have changed the conditions under which the picture was produced, we have no means of determining the extent to which this may have introduced error; certainly we have no scientific ground on which to affirm that we

have increased the accuracy of the representation. We should aim to reproduce what we saw under the most carefully adjusted conditions and after the most sedulous care to correct the instrument properly in all respects. That is, as it would seem, the only possible test of the performance of such an optical instrument as the microscope.

Mr. Walmsley having returned with an excellent negative of the object photographed, the discussion turned upon the making of paper prints. After describing the usual silver print process, Mr. W. exhibited some beautiful specimens of the permanent bromide prints. The advantage of these is found in the fact that the printing may be done by lamplight and with great rapidity. The developing process takes about as much time as the toning of the silver print, and about as much labor. For many subjects, Mr. W. said, the rough surface of the bromide paper gives an admirable effect. If a smooth and burnished surface is desirable it may be obtalned by "squilgeeing" the print, surface down, upon a smooth plate of hard vulcanite rubber and letting it dry in that situation. If it is desirable to save the time of toning and fixing the silver prints, or developing the bromide prints, the best and most rapid process known is the "blue printing" as the *ferro-prussiate* process is called.

Mr. Cox stated that he had been surprised to find how much difference there was in the time taken to make blue prints by means of different samples of paper. He had formerly supposed, from his experience with ordinary brands of imported *ferro-prussiate* paper, that from three to five times as long an exposure to the sun would be needed to make a blue print as was necessary for a silver print, and this went far to counterbalance the saving of time and trouble by getting rid of the toning and fixing processes. He had found, however, that the "blue" papers varied greatly in rapidity, and some samples which he had lately used had required only half the average time of silver printing. He had not leisure to prepare his own paper and was obliged therefore to buy it at the shops, and suggested that those who had experience on the subject should give information.

Mr. Woolman inquired whether part of the difficulty was not in the *staleness* of the paper; he had found freshly prepared paper the

more rapid in printing, and that to keep it good it must be carefully protected from both light and moisture. Paper is specially made for this purpose in the United States, in Germany and in France. It is in rolls of varying widths and thicknesses. For microscopical work he would recommend the "extra thin" paper, and that the members should prepare it themselves so as to be sure it is fresh.

Mr. Cox said he had found no change in paper used by him after keeping it several weeks; but he was very careful to keep it in a dry closet and to roll it in "needle paper," or the orange envelope paper, turning in the wrapping paper at the ends so as to exclude all light.

Mr. Alling said he could recommend paper made for this purpose by the Hurlbut Paper Company, South Lee, Mass. It was furnished in different thicknesses and sized.

Mr. Cox said it might be well to add a word of warning against using any blotting paper to dry or to pack the blue prints, except such as was known to be clean. He had once packed some damp prints between blotters which had been received from Mr. Walmsley with some silver paper which had been packed in them. To his surprise he had found these blue prints afterwards spotted with white as if flour had been sprinkled over them. He could only guess that the sheets of blotting paper had been saturated with carbonate of soda as was sometimes done to help preserve the sensitiveness of the silver paper, but he was not chemist enough to know how this had affected the blue prints. A friend who had seen them had doubted whether the soda could have caused the difficulty, assuming that the blue was a "Prussian blue," which is almost unalterable.

Mr. Walmsley said it was the fact that his silver prints had been packed as Mr. Cox guessed, in blotting paper containing carbonate of soda; but he left others to tell how this affected the blue prints.

Mr. Stratton agreed with those who had recommended that the paper be prepared by him who used it, in order to secure freshness. He should not choose to keep it more than a week or two and then only by putting it in a thoroughly dry and dark place. A good linen "ledger paper," which can be got at any printer's, he found excellent for this purpose, though unalbumenized photographic paper is probably the best.

The formula he used was :

a	Red prussiate of potash	1 oz.
	Water	6 oz.
b	Citrate of iron and ammonium	1 oz.
	Water	4 oz.
	Citric acid	10 to 20 gr.

Mix equal quantities of *a* and *b*, and apply to the paper with a swab made of Canton flannel wound a stick eight inches long, so that the whole width of eight inches may be used to apply the mixture evenly to the paper. The paper may be laid flat on a table to dry, and should be perfectly dry before using.

Mr. Charles Ehrmann spoke in substance as follows :

"It has been mentioned here how Prof. Pickering, of Harvard College, has been enabled to photograph the optically invisible nebulæ of the *Pleiades*. As well as Victor Schumann and Captain Abney have photographed the ultra red of the spectrum upon ortho-chromatic, that is, color-sensitive plates, may not the learned professor have been induced to use that kind of plates for his astro-photographic experiments? The idea suggested itself to me, as I have been informed Prof. Pickering has experimented with hyaline.

"Several inquiries have been made of me in the course of this day, as to a possible application of colored plates in photomicrography. There can hardly be any doubt as to their practicability, and an advantageous result of their use, in many cases, but it must be left to the specialist to experiment in that direction.

"By my own experience I am led to advise those feeling inclined to take up ortho-chromatic photography to adopt the methods of Messrs. Mallmann & Scolic, of Vienna, which may be found in detail in the later numbers of *The Photographic Times*.

"If I had to make blue prints in large numbers, I would discard paper prepared long before it is used. Its sensitiveness decreases by age, a decomposition takes place before exposure, aud consequently perfectly pure whites are difficult to obtain. The formula I have employed to make blue paper is as follows:

a.	Ferricyanide of potassium	1 oz.
	Water	4 oz.
b.	Ammonio-citrate of iron	1 oz.
	Water	4 oz.

Mix equal volumes of the two solutions and spread over a sheet of Rives plain paper, by means of a tuft of cotton or a *Buckles* brush

and hang up to dry. I select large crystals of the prussiate, wash them, to liberate them from any decomposed salt adhering, and dry with bibulous paper, before I weigh out the quantity wanted.

"About ten per cent. more of the iron solution tends to give the print more vigor and brilliancy. Many beginners in photography complain of week prints; they simply do not print deep enough.

"The blue deposit is not, as has been stated, Prussian blue, but *Trombull* blue, resulting from Ferro-cyanide of potassium and a ferrous salt."

Mr. Vorce gave the results of considerable experience with blue prints or cyanotypes, embodying several formulæ which he had tested, with remarks upon the same, as follows:

FORMULÆ FOR PREPARING THE SAME.

No. 1. A quick-printing paper for immediate use, keeps good for a few days, but prints slower as it gets older:

℞ Ferricyanide of potassium (red prussiate of potash)..... ¾ oz.
Ammonio-citrate of iron............................1½ oz.

Dissolve each in 8 fluid oz. distilled water, mix as soon as dissolved and use immediately. Coat the paper evenly with a wide brush, so as to leave no streaks, and blot off excess of solution to prevent spottiness. Dry in a current of cool air in the dark. Print in direct sunlight according to negative, but not too deep. Wash in clear running water in the dark until the high lights and unprinted parts are a clear, pure white; then dry. The above formula gives a bright, clear blue color.

No. 2. English formula; paper keeps longer, but prints slower than the above; gives a slightly darker blue.

℞ { Ferricyanide of potassium........................ 1 oz.
{ Water...8 oz.
{ Ammonio-citrate of iron...........................1 oz.
{ Water...8 oz.

Treatment same as above.

No. 3. Commercial formula. Used by engineers, draughtsmen and many others for copying plans, drawings of machinery, etc. Rather a slow printing paper, but strong, dark color.

℞ { Ferricyanide of potassium..........................1 oz.
{ Water...4 oz.
{ Ammonio-citrate of iron......................... ..1 oz.
{ Water...4 oz.

Treatment same as before described.

No. 4. A good printing paper when fresh, slower than No. 1, but darker color, and giving good contrasts.

℞ By weight.

Ferricyanide of potassium	16 parts.
Water	100 "
Ammonio-citrate of iron	24 "
Water	100 "
Gum acacia	2 "
Water	100 "

Mix equal volumes of the two solutions. Treatment same as in other cases.

GENERAL REMARKS.

1. The paper used for blue prints should be free from any trace of soda to insure permanency of the prints. No better paper can be found for the purpose than that known as "photographic plain paper," since all papers prepared for photographers' use are free from soda. Albumen paper can be used for cyanotypes, but is more difficult to coat evenly in large sheets than plainer paper.

2. The water used for all the solutions should be distilled, or at least free from lime or soda. And the purer the water used for washing the prints the better will be the result.

3. The solutions should always be mixed immediately before use, and should be used in the dark. A good plan is to mix the solutions and coat the paper in the evening, which may be done by gaslight, and hang it in a *dark* closet or room to dry. In the morning the paper will be dry and can be put into light-tight boxes until used, which should be done the same day, if possible, as it works much better when fresh. One ounce of the mixed solution will coat ten or twelve square feet of paper if carefully used.

4. The paper should be printed to a steel gray color in the lights, and the washing is best done in running water and in the dark or by gaslight. Washing by daylight will not spoil the print if the washing is not too prolonged.

5. Over-printed prints can be reduced by a very weak solution of carbonate of soda, but are not likely to be permanent; and the prints are so cheaply and quickly made that it is wasting time to try to improve a bad print by reducing or otherwise.

The beautiful-plates of diatoms in Schmidt's Atlas, which were copied and reduced by Prof. C. H. Kain, of Camden, N. J., in cyanotype, show how finely detail is reproduced by this process.

The plates printed by Prof. Kain were by formula No. 1, above given, which is stronger in iron than any of the others. The bright color of his plates for that class of work seems preferable to a darker color. The prints of butter and fat crystals exhibited by Dr. H. J. Detmers, of Columbus, O., at the present meeting, were produced by formula No. 4, furnished by Prof. A. H. Tuttle. The prints of diatoms exhibited by Hon. J. D. Cox, at the Cleveland meeting were, in all probability, produced by formula No. 3, as that formula is given in many books and is much used.

There is a method of cyanotype printing in which the paper is sensitized in a solution of an iron salt, and after printing developed in a solution of the potassium salt; but it is much more troublesome and no better than the usual method as above described.

THE GENERAL SESSION.

The exhibitors were promptly at their tables pursuant to adjournment. A printed programme had been distributed, giving briefly the work to be accomplished at each of forty tables arranged by those in charge about the spacious room, and most convenient for the large number of the Society and others who witnessed the work that interested them most.

Some for whom a plan had been prepared were not able to attend; in the following account of the individual work the members of unoccupied tables are omitted.

No. 1. Dr. C. M. Briggs, of Fairport, N. Y., placed a drop of fresh blood a little to the left of the center of the slide, and another slide, with the edge placed crosswise and at an angle, was drawn from left to right, thus wiping off most of the blood and leaving a thin layer of blood discs flatwise on the slide. This is allowed to dry, then the slide is placed on the turn-table, centered, and the blood turned down to a circle of the desired size. To stain the corpuscles, the slide is flooded with a solution of eosine and allowed to stand from three to five minutes, then flooded with water to wash it, and again allowed to dry, after which a small drop of balsam and benzole is placed on the slide, covered and heated cautiously. A little practice will enable anyone to mount blood nicely in this way.

No. 4. Mr. W. H. Brearly, Detroit, Mich., exhibited a portable holder for optical instruments.